

DP-309706

CLAIMS

What is claimed is:

- 5 1. A combination valve for fuel delivery system of a vehicle having an engine, the fuel delivery system being configured to pump fuel to the engine and the fuel delivery system has a regulator for regulating the pressure of the fuel when it is being pumped to the engine by the fuel delivery system, the combination valve comprising:
- 10 an outer housing defining an inner opening for slidably receiving a body portion of a system pressure relief valve therein, said body portion of said system pressure relief valve defining an inner opening for slidably receiving a body portion of a check valve therein, said body portion of said check valve being configured to provide a first fluid pathway in a first direction when said
- 15 body portion of said check valve moves from a closed position to an open position as said body portion of said check valve moves in said first direction within said inner opening of said body portion of said system pressure relief valve, said body portion of said system pressure relief valve being configured to provide a second fluid pathway in a second direction when said body portion of
- 20 said system pressure relief valve moves from a closed position to an open position as said body portion of said system pressure relief valve moves in said second direction within said inner opening of said outer housing, wherein said first direction being opposite to said second direction.
- 25 2. The combination valve as in claim 1, wherein said first direction is the direction fuel flows to the engine when the pump is pumping fuel to the engine.

DP-309706

3. The combination valve as in claim 1, wherein said outer housing is formed out of brass.
4. The combination valve as in claim 1, wherein a portion of said
5 second fluid pathway is disposed between said inner opening of said body portion of said pressure relief valve and an outer surface of said body portion of said system pressure relief valve.
5. The combination valve as in claim 4, wherein said outer surface
10 of said body portion of said system pressure relief valve is configured to engage a biasing member disposed between said outer surface of said body portion of said system pressure relief valve and a portion of a valve seat member of said system pressure relief valve, said biasing member providing a biasing force for maintaining said system pressure relief valve in said closed position.
15
6. The combination valve as in claim 5, wherein said valve seat member of said system pressure relief valve is disposed on said inner opening of said outer housing.
- 20 7. The combination valve as in claim 6, wherein said valve seat member of said system pressure relief valve is configured to engage a sealing member of said system pressure relief valve when said pressure relief valve is in said closed position.
- 25 8. The combination valve as in claim 7, wherein said sealing member of said system pressure relief valve is an O-ring secured to a portion of said body portion of said system pressure relief valve.

DP-309706

9. The combination valve as in claim 8, wherein the biasing member engaging said valve seat member of said system pressure relief valve determines the amount of pressure required to open said system pressure relief valve, which is greater than the pressure at which the regulator regulates the fuel when it is being pumped to the engine.

10. The combination valve as in claim 9, wherein a portion of said first fluid pathway is disposed between an inner opening of said body portion of said check valve and an outer surface of said body portion of said check valve.

10

11. The combination valve as in claim 10, wherein said outer surface of said body portion of said check valve is configured to engage a biasing member disposed between said outer surface of said body portion of said check valve and a portion of a valve seat member of said check valve, said biasing member providing a biasing force for maintaining said check valve in said closed position.

15

12. The combination valve as in claim 11, wherein said valve seat member of said check valve is disposed on said inner opening of said body portion of said system pressure relief valve.

20

13. The combination valve as in claim 12, wherein said valve seat member of said check valve is configured to engage a sealing member of said check valve when said check valve is in said closed position.

25

14. The combination valve as in claim 13, wherein said sealing member of said check valve is an O-ring secured to a portion of said body portion of said check valve.

DP-309706

15. The combination valve as in claim 14, wherein said system pressure relief valve is a valve which allows flow therethrough under a first set of conditions or pressures, while preventing back flow and said check valve is a valve which allows flow therethrough under a first set of conditions or pressures, while preventing back flow.

16. The combination valve as in claim 15, wherein the regulator has a relief setting of approximately 400 kPa and said pressure relief valve opens at approximately 600 kPa and said check valve opens at approximately 20 kPa.

10

17. A combination valve for fuel delivery system of a vehicle having an engine, the fuel delivery system being configured to pump fuel to the engine and the fuel delivery system has a regulator for regulating the pressure of the fuel when it is being pumped to the engine by the fuel delivery system, the combination valve comprising:

an outer housing defining an inner opening for slidably receiving a body portion of a pump pressure relief valve therein, said body portion of said pump pressure relief valve defining an inner opening for slidably receiving a body portion of a system pressure relief valve therein, said body portion of said system pressure relief valve defining an inner opening for slidably receiving a body portion of a check valve therein, said body portion of said check valve being configured to provide a first fluid pathway in a first direction when said body portion of said check valve moves from a closed position to an open position as said body portion of said check valve moves in said first direction within said inner opening of said body portion of said system pressure relief valve, said body portion of said system pressure relief valve being configured to provide a second fluid pathway in a second direction when said body portion of said system pressure relief valve moves from a closed position to an open position as said body portion of said system pressure relief valve moves in said

DP-309706

second direction within said inner opening of said pump pressure relief valve, said body portion of said pump pressure relief valve being configured to provide a third fluid pathway in a said first direction when said body portion of said pump pressure relief valve moves from a closed position to an open position as
5 said body portion of said pump pressure relief valve moves in said first direction within said inner opening of said outer housing, wherein said first direction being opposite to said second direction.

18. The combination valve as in claim 17, wherein said first
10 direction is the direction fuel flows to the engine when the pump is pumping fuel to the engine and a portion of said second fluid pathway is disposed between said inner opening of said body portion of said pump pressure relief valve and an outer surface of said body portion of said system pressure relief valve.

15

19. The combination valve as in claim 18, wherein said outer surface of said body portion of said pressure relief valve is configured to engage a biasing member disposed between said outer surface of said body portion of said system pressure relief valve and a portion of a valve seat member of said
20 pump pressure relief valve, said biasing member providing a biasing force for maintaining said system pressure relief valve in said closed position.

20. The combination valve as in claim 19, wherein said valve seat member of said system pressure relief valve is disposed on said inner opening of
25 said body portion of said pump pressure relief valve.

21. The combination valve as in claim 20, wherein said valve seat member of said system pressure relief valve is configured to engage a sealing

DP-309706

member of said system pressure relief valve when said system pressure relief valve is in said closed position.

22. The combination valve as in claim 21, wherein said sealing
5 member an O-ring.

23. The combination valve as in claim 21, wherein the biasing
member engaging said valve seat member of said system pressure relief valve
determines the amount of pressure required to open said system pressure relief
10 valve, which is greater than the pressure at which the regulator regulates the fuel
when it is being pumped to the engine.

24. The combination valve as in claim 23, wherein a portion of said
first fluid pathway is disposed between an inner opening of said body portion of
15 said check valve and an outer surface of said body portion of said check valve
and said outer surface of said body portion of said check valve is configured to
engage a biasing member disposed between said outer surface of said body
portion of said check valve and a portion of a valve seat member of said check
valve, said biasing member providing a biasing force for maintaining said check
20 valve in said closed position, wherein said valve seat member of said check
valve is disposed on said inner opening of said body portion of said system
pressure relief valve.

25. The combination valve as in claim 23, wherein said valve seat
25 member of said check valve is configured to engage a sealing member of said
check valve when said check valve is in said closed position.

DP-309706

26. The combination valve as in claim 25, wherein said system pressure relief valve is a valve which allows flow therethrough under a first set of conditions or pressures, while preventing back flow.

5 27. The combination valve as in claim 26, wherein the regulator has a relief setting of approximately 400 kPa and said system pressure relief valve opens at approximately 600 kPa and said check valve opens at approximately 20 kPa.

10 28. The combination valve as in claim 26, wherein a portion of said third fluid pathway is disposed between said inner opening of said outer housing and an outer surface of said body portion of said pump pressure relief valve and said outer surface of said body portion of said pump pressure is configured to engage a biasing member disposed between said outer surface of said body
15 portion of said pump pressure and a portion of a valve seat member of said pump pressure valve, said biasing member providing a biasing force for maintaining said pump pressure valve in said closed position, wherein said valve seat member of said pump pressure valve is disposed on said inner opening of said body portion of said outer housing valve.

20

29. The combination valve as in claim 28, wherein said valve seat member of said pump pressure valve is configured to engage a sealing member of said pump pressure valve when said pump pressure valve is in said closed position.

25

30. A combination valve for a pump of a fuel delivery system of a vehicle having an engine, the fuel delivery system being configured to pump fuel to the engine, the combination valve comprising:

DP-309706

an outer housing defining an inner opening for slidably receiving a body portion of a pump pressure relief valve therein, said body portion of said pump pressure relief valve defining an inner opening for slidably receiving a body portion of a check valve therein, said body portion of said check valve
5 defining, said body portion of said check valve being configured to provide a first fluid pathway in a first direction when said body portion of said check valve moves from a closed position to an open position as said body portion of said check valve moves in said first direction within said inner opening of said body portion of said pump pressure relief valve, said body portion of said pump
10 pressure relief valve being configured to provide a second fluid pathway in said first direction when said body portion of said pump pressure relief valve moves from a closed position to an open position as said body portion of said pump pressure relief valve moves in said second direction within said inner opening of said outer housing, said combination valve being configured to be in fluid
15 communication with an outlet port of the pump, wherein said check valve opens under a lower pressure than said pump pressure relief valve.

31. The combination valve as in claim 30, wherein an outer surface of said body portion of said pump pressure relief valve is configured to engage a
20 biasing member disposed between said outer surface of said body portion of said pump pressure relief valve and a portion of a valve seat member of said pump pressure relief valve, said biasing member providing a biasing force for maintaining said pump pressure relief valve in said closed position and said valve seat member of said pump pressure relief valve is disposed on said inner
25 opening of said outer housing.

32. The combination valve as in claim 31, wherein said valve seat member of said pump pressure relief valve is configured to engage a sealing

DP-309706

member of said pump pressure relief valve when said pump pressure relief valve is in said closed position.

33. The combination valve as in claim 32, wherein a portion of said
5 first fluid pathway is disposed between an inner opening of said body portion of
said check valve and an outer surface of said body portion of said check valve
and said outer surface of said body portion of said check valve is configured to
engage a biasing member disposed between said outer surface of said body
portion of said check valve and a portion of a valve seat member of said check
10 valve, said biasing member providing a biasing force for maintaining said check
valve in said closed position, wherein said valve seat member of said check
valve is disposed on said inner opening of said body portion of said pump
pressure relief valve.

15 34. The combination valve as in claim 33, wherein said valve seat
member of said check valve is configured to engage a sealing member of said
check valve when said check valve is in said closed position and said pump
pressure relief valve and said check valve are valves which allow flow
therethrough under a first set of conditions or pressures, while preventing back
20 flow.